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Social determinants of health and diabetes self-care management in South Africa

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Abstract

Objective Diabetes is an incapacitating condition affecting millions of people in South Africa. Maintaining optimal glycaemic control is crucial in preventing diabetes complications, highlighting the importance of diabetes self-care. This study examined how Social Determinants of Health (SDoH) are associated with self-care management practices in individuals with diabetes in South Africa using the framework developed by the Healthy People 2020 initiative.

Methods This study utilised cross-sectional Project Mind baseline data collected in 2017. Self-care management was coded on a scale from '0' (never) to '7' (daily adherence). For analysis, this scale was dichotomised into two categories: low self-care (scores 0–5) and high self-care (scores 6–7). Furthermore, adherence with these daily self-care activities was categorised into three levels: no adherence, partial adherence (inconsistent or partial adherence to activities), and full adherence (consistent adherence to all self-care activities).

Results The analytical sample (*n* = 539) was predominantly female (76%), with a mean age of 54 years, urban residents (60%), unemployed (70%), and attained secondary education (11.3%). In determining the attainment of a higher scale of self-care, age (AOR = 1.02, CI=[0.99,1.05]) and secondary education (AOR = 1.13, CI=[1.02, 2.03]) were associated with an increase in the scale of self-care. Conversely, urban residency (AOR = 0.50, CI=[0.29,0.88]) and being obese (AOR = 0.43, CI=[0.19,1.00]) were associated with a lower scale of self-care. Although not statistically robust, food insecurity decreased while being a woman and having a stable house showed an increased association. Travelling longer distances to access healthcare was positively associated with no adherence, and urban residency has a negative association with full adherence relative to partial adherence.

Conclusions The associations between SDoH and diabetes self-care management within a South African context highlight the need for a more holistic understanding and approach to interventions. Future endeavours should examine these determinants more broadly and formulate integrative strategies to ameliorate diabetes self-care.

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Introduction

Diabetes is a prevalent lifestyle-related disease that imposes substantial financial strains on healthcare systems worldwide. In 2021, the global cost of diabetes was approximately $966 billion, a figure that's expected to surge due to increasing prevalence and treatment expenses [1, 2]. Within this global context, South Africa's diabetes-related health expenditure in the same year was estimated to be US$7.2 billion by the International Diabetes Federation (IDF) [2]. This significant national expense can be attributed to late diagnosis and inadequate self-care management, leading to increased comorbidities [2].

Self-care management, appropriate access to healthcare services, and regular consultations with healthcare providers about diabetes status are crucial in improving glycated haemoglobin (HbA1c) levels [3]. Evidence suggests that individuals with diabetes who exhibit a higher degree of self-care management tend to have fewer healthcare facility visits [4, 5]. This is due to the fact that enhanced self-care practices lead to improved health outcomes, including reduced need for emergency services or care for complications [4]. This reduction can decrease the incidence of diabetes-related complications such as retinopathy, nephropathy, and neuropathy [4, 5].

The literature has shown that Social Determinants of Health (SDoH) - the socioeconomic conditions in which individuals work, live, and age - play a substantial role in influencing health outcomes [6, 7]. The United States Centers for Disease Control and Prevention (CDC) characterised SDoH as economic and social situations that influence the health of people and communities [7]. Some key SDoH domains include sociodemographic, economic, health and healthcare, lifestyle, and social capital [6, 8, 9]. These circumstances are shaped by the distribution of money, power, and resources, primarily responsible for health inequities and unfair and avoidable differences in health status between communities and individuals [8, 10].

The socioeconomic domain is traditionally gauged by income, education, and occupation [11, 12], yet factors like housing, healthcare accessibility, insurance coverage, residence area, lifestyle, and social capital also contribute to these evaluations [13, 14]. Intertwined with life-course vulnerability from prolonged exposure to resource-deprived environments, these attributes significantly impact disparities in disease risk, diagnosis, and outcomes [9, 10, 12, 15]. These aspects could be improved by changing relevant policies because the determinants are often a result of unequal social and economic statuses or systems. South Africa has policies for mitigating non-communicable diseases (NCDs) but lacks practical implementation [16–19]. As a result, the SDoH remain the primary contributor to unfair and avoidable differences in health status, including the increased risk of diabetes and diabetes-related complications [18, 20, 21].

Addressing SDoH remains prominent on the universal healthcare agenda in line with the goals and priorities outlined by WHO [22, 23]. However, South Africa has stark social inequities, translating into a high burden of health inequities and premature deaths among people with diabetes [17]. The country has one of the highest numbers of people with diabetes in sub-Saharan Africa (SSA), with an estimated 4.2 million people with diabetes aged 20–79 years in 2021 [2]. The burden disproportionately affects the 'economically disadvantaged', leading to higher rates of morbidity and mortality due to limited access to healthcare, education, and necessary management resources [20, 24]. Addressing social determinants is believed to be a cornerstone of the National Department of Health's Primary Healthcare (PHC) Re-engineering Strategy [19]. The government's commitment to prioritise PHC with its focus on SDoH was endorsed in the Health Act (61 of 2003). However, implementing it has been challenging because of a lack of political and policy commitments from various stakeholders within the government [19, 20].

Although research has demonstrated the importance of SDoH in shaping health generally [4, 24, 25], evidence pertaining to diabetes often revolves around understanding its prevalence and clinical outcomes. In contrast, investigations into how various SDoH factors intersect with diabetes self-care management have been limited. This study aimed to elucidate the relationship between traditional and less frequently studied SDoH factors and their impact on diabetes self-care management and healthcare-seeking adherence behaviours. By doing so, we sought to deepen the understanding of how various SDoH elements influence patient self-care management and adherence behaviours in diabetes care. This South African study employed a unique 5-domain SDoH framework developed by the Healthy People 2020 (HP2020) initiative, also known as the SDoH factors [26]. Using the HP2020 domains, such as demographic status, economic factors, education domains, lifestyle domains and healthcare domains, this study examined self-care management as well as determinants of adherence among individuals with diabetes.

Methods

Study data, design and population

The data for this study were sourced from Project MIND, a clustered randomised controlled trial integrating psychological treatment into chronic disease care in the Western Cape, South Africa [27]. Conducted across 24 HIV and diabetes clinics in the Western Cape,

Table 1 Definitions and Scoring Criteria for Self-Care and Adherence categories

Domain	Score = -1	Score > 0 & <= 5	Score >= 6
Last seven days' health eating plan	Non-Adherent	Partially Adherent	Fully Adherent
Last seven days doing at least 30 min of physical activity	Non-Adherent	Partially Adherent	Fully Adherent
Last seven days checking one's feet	Non-Adherent	Partially Adherent	Fully Adherent
Outcome Variable	Definition		
Self-Care Score = 1 (High)	All domains scored 6 or above		
Self-Care Score = 0 (Low)	Any domain scored below 6		
Fully Adherent (Category 1)	All domains scored 6 or above		
Non-Adherent (Category 3)	All domains scored -1		
Partially Adherent (Category 2)	Any combination of scores not fitting into categories 1 or 3		

it included 15 urban and nine rural facilities. In 2017, Project MIND[1] enrolled 1340 participants aged 18 and above, receiving treatment for HIV and/or diabetes from selected clinics. For this sub-study, baseline data from 539 participants exclusively diagnosed with diabetes was utilised. Detailed methodology is available from Myers et al. (2018) [27].

Analysis and measures

In this analysis, key independent variables and outcomes were first cross-tabulated against the dependent variable, self-care management, to observe initial patterns and relationships. Subsequently, binary logistic regression was applied to examine the association between the independent variables and self-care management scales categorised into low and high self-management. Multinomial logistic regression was utilised to explore the relationships between the independent variables and the different categories of self-care adherence (no, partial, and full).

Outcome variables

i. ***Diabetes self-care management and adherence categories***

Diabetes self-care was measured with the Summary of Diabetes Self-care Activities Scale [28]. Participants were asked about their daily self-care activities over the last seven days using the following three domains: following a healthy eating plan, doing at least 30 minutes of physical activity, and checking their feet. Participants rated the extent to which they implemented the activity on a scale from 0 (not following the activity at all) to 7 (following the activity every day of the past week). To assess overall self-care, a dichotomous dependent variable was created, categorising self-care as 'Low' for those participants who scored between 0 and 5 in any of the domains, indicating less frequent or incomplete adherence, and 'High' for scores of 6 or 7 in all domains, reflecting consistent daily adherence to all three activities. The creation of a dichotomous dependent variable aligns with Agidew et al. (2021), who employed percentage-based adherence scores and found that self-care practices conducted with >75% adherence, equivalent to 6 or 7 days a week in our analysis, significantly improved diabetes outcomes [29]. Furthermore, self-care was additionally categorised into three adherence levels: 'No adherence' signifies no adherence to any activities, capturing a complete lack of engagement in self-care; 'Partial adherence ' indicates adherence to some but not all activities, reflecting varying degrees of engagement; and 'Full adherence' represents adherence to all three activities, denoting optimal self-care adherence (Table 1).

Independent variables

This study employed the socio-ecological framework from Healthy People 2020, which is designed to elucidate SDoH [30, 31]. This framework aids in creating evidence-based resources and tools by systematically categorising SDoH into distinct domains, as explained below:

i. ***Demographic domain***

Differences in diabetes self-management behaviours based on age, gender, marital status, and study site (urban vs. rural) have been shown to be associated with differences in self-management [32]. These factors were investigated in the South African context.

[1] Project MIND is a collaborative research study between the South African Medical Research Council (SAMRC), the University of Cape Town, Oxford University, and the Western Cape Department of Health (WCDoH). The purpose of this study is to develop two collaborative care models for mental health and chronic disease care and to test which of these models is the most effective for improving mental health and chronic disease outcomes.

ii. ***Economic stability domain***

The household monthly average income, employment status, food security, and stable living conditions were considered due to their reported impact on diabetes self-care management [5, 33]. To quantify household income, interval regression was employed to transform categorical income bands into quantitative measures. Employment status was categorised into a binary variable, indicating either 'employed' or 'unemployed.' Similarly, food security and housing stability were each coded as binary variables. For these, a '1' represented the presence of food security and stable living conditions, while a '0' indicated the absence of these conditions.

iii ***Education domain***

The level of education was evaluated to understand their relationship with self-care and health outcomes among individuals with diabetes. Education was assessed by the question, "What is the highest level of education you have passed?". It was recorded as binary: primary school and some secondary education '0' and completed high school and further studies '1.'

iv. ***Lifestyle domain***

This domain included lifestyle exposures (i.e., alcohol, tobacco, and illicit drug use). The impact these substances have on health is well documented [29]. In this domain, alcohol use was assessed using the Alcohol Use Disorders Identification Test (AUDIT). The categorisation included no drinking, low-risk drinking (<8), hazardous drinking (8–15), and harmful drinking (>16). However, due to small frequencies in the hazardous and harmful categories, we consolidated the data into low-risk (<8) and harmful/hazardous drinking (>8). Individuals with an AUDIT score<8 were coded as low-risk, while those with a score>8 were classified as hazardous or harmful. Smoking and drug use were coded as 'no' and 'yes' for current smoking or illicit drug use. However, 98% of the study participants reported 'no' to drug use. Thus, the variable was dropped, given the absence of adequate variation.

xxii. ***Health and healthcare domains***

The health domain comprises well-being, which is vital for managing diabetes, whereby obesity, defined as body mass index (BMI) > 30 kg/m^2, is a leading risk factor [13, 34]. BMI data was recoded into three categories—normal (BMI < 25 kg/m^2), overweight (25 ≤ BMI < 30 kg/m^2), and obese (BMI > 30 kg/m^2). Once diagnosed with diabetes, effective management is crucial and necessitates accessing healthcare services for treatment and regular diabetes monitoring [35]. Travel time to the clinic, measured in continuous minutes and categorised for analysis, served as a proxy for healthcare access, with longer times indicating greater barriers to accessing medical services [35].

Statistical analysis

This study employed a binary logistic regression for its primary analysis, presented in Eq. 1, to assess the influence of SDoH on adherence to diabetes self-care. The dependent variable was recorded as a '0' for low and a '1' for high (>75%) adherence self-care practices.

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n, \tag{1}$$

The β coefficients represent the change in the log-odds of achieving higher self-care for a one-unit change in the predictor variables (X), holding other variables constant. While describing the dependent variable's log of odds in a binary logistic regression model, P is the probability of the event occurring (e.g., a higher scale of self-care management).

Furthermore, a secondary analysis assessed factors associated with different degrees of adherence to self-care using the multinomial logistic regression presented in Eq. 2. The study data was categorised into three levels of adherence categories (no, partial and full adherence).

$$Logit\left(P\left(Y=j|X\right)\right) = \ln\left(\frac{P\left(Y=j|X\right)}{P\left(Y=j|X\right)}\right) = \beta_{0j} + \beta_{1j} X_1 + \beta_{2j} X_2 + \cdots + \beta_{pj} X_p \tag{2}$$

Where Logit(P(Y = j|X)) is the log-odds of outcome j relative to a reference category. β1j, β2j., and βpj are the coefficients to be estimated for outcome j. X1, X2., and Xp are the independent variables. P(Y = j|X) is the probability of the outcome j given the independent variables X. Analysis was conducted using Stata software, version 17, to perform statistical computations and interpret the data [36].

Results

Demographic characteristics

Table 2 describes the sociodemographic and other characteristics of the analytical sample ($n = 539$). Gender ($p = 0.419$) was not significantly associated with the variability of self-care management. Female participants accounted for 76% of the sample size, and the mean age

Table 2 Descriptive characteristics of the analytic sample ($n=539$)

Variables	Description	*n*	%
Gender		n = 539	
	Male	128	26.4
	Female	411	73.6
Age[a]	Age in years	54 ($\bar{x}$)	10.8 (sd)
Marital status	Not married	267	49.5
Study site	Rural	199	36.9
Education level	Primary and some secondary school completed Secondary education completed	478 61	88.7 11.3
Employment Status	Unemployed	378	70.1
Predicted monthly income (ZAR)[b]	Mean Lower limit Upper limit	1799 ($\bar{x}$) 1029 2903	524 (sd) 46.1 18.2
Food security	Insecure	133	24.7
Stable living	No	82	15.2
Self-care scales	Low (≤5 days out of 7) High (≥6 days out of 7)	476 63	88.3 11.7
Self-care adherence categories	No adherence (0 of 7) Partial adherence (1–6 of 7) Full adherence (7 of 7)	12 463 64	2.2 85.9 11.9
AUDIT score	No/low risk Hazardous/Harmful	397 142	73.6 26.3
Smoking	None smoker Current smoke	408 131	75.6 24.3
Drug use	Yes	7	1.3
BMI score	Normal (BMI < 25 kg/m^2) Overweight (BMI25-30 kg/m^2) Obese (BMI > 30 kg/m^2)	79 290 170	15.9 58.8 31.5

[a] Mean and standard deviation were reported, [b]Mean, minimum and maximum reported, *sd* standard deviation, $\bar{x}$ mean, *CI* confidence interval

was 54.3 ± 11 years. Half the participants were married or cohabiting, and 60% accessed treatment at an urban or peri-urban clinic. In terms of employment, 70% of the sample was unemployed, and 11.3% had achieved secondary and further education. The predicted lower average household monthly income limit in South African Rand (ZAR) was ZAR1029 (US$55.78), and an upper limit of ZAR2903 (US$157.35), with the predicted average monthly patient income of ZAR1799 (US$97.49). About 25% of the participants expressed some level of food insecurity. A stable living situation was absent for 15% of participants. Only 12% of the participants engaged in high levels of self-care by achieving a score of 6 or more out of a maximum of 7 on the self-care scale.

Further analysis that assessed the level of adherence to diabetes self-care indicated that 2% of the participants reported complete none-adherence, 86% were partially adherent, that is they only did some of the self-care activities (for example, six days of checking feet and 0 days of healthy eating or physical exercise or vice versa). On the other hand, 12% of participants reported being fully adherent to recommended practices. One-fourth of the participants reported smoking cigarettes, pipes, or chewing tobacco, while 26% of the participants reported harmful/hazardous alcohol use. Drug use was infrequent, reported by less than 2% of the participants. Among the participants, 59% were overweight, and 31% were obese (BMI > 30). The Society of Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA) guidelines recommend that individuals with diabetes undergo check-ups every three to six months [37]. However, our data revealed varying levels of adherence to this guideline.

Table 3 illustrates participants' adherence to individual diabetes self-care practices, revealing varying levels

Table 3 Domain-wise distribution of self-care practices among participants, $n=539$

Self-care practices	Lower scale (0 to 5)		Higher scale (6 and 7)	
	n	%	*n*	%
Followed the recommended daily eating plan in the past 7 days	371	69	168	31
Engaged in at least 30 min of physical activity daily in the past 7 days	335	62	204	38
Checked feet daily in the past 7 days	260	48	279	52

of adherence to each practice. Adherence to a recommended daily eating plan was the least commonly implemented self-care strategy, with only 31% of participants being fully adherent to this guideline. Physical activity for at least 30 min daily was reported by 38% of the sample, while daily foot care was the most practised self-care activity, with 52% of participants reporting full adherence. Only 2% of participants demonstrated no adherence, almost 86% exhibited partial adherence, and about 12% achieved full adherence to diabetes self-care.

Sdoh and self-care management

The primary findings regarding the association between binary self-care management and predictor variables are outlined in Table 4. Following this, a binary logistic regression analysis was conducted, revealing age, receiving care from clinics in urban settings, secondary and higher education, stable housing, and elevated BMI score as statistically significant predictors ($p < 5\%$) of self-care.

A one-year increase in age yielded an adjusted odds ratio (AOR) of 1.02 (95% CI = 0.99, 1.05; $p = 0.04$), suggesting a modest increase in the likelihood of higher self-care associated with an increase in age. Conversely, residing in areas served by clinics located in urban settings, particularly in townships, reduced the odds of higher self-care compared to individuals in rural areas, with an adjusted odds ratio (AOR) of 0.54 (95% CI = 0.30, 0.97; $p = 0.03$). Secondary and further education was linked to higher self-care odds compared to those who completed only primary school and had some high school, with an AOR of 1.13 (95%CI = 1.02, 2.03; $p = 0.05$). For overweight individuals, the adjusted odds ratio (AOR) of 0.57 (95%CI = 0.28, 1.16) suggested a trend toward lower self-care. However, this result did not reach statistical significance at the conventional alpha level of 0.05, as indicated by the p-value of 0.1 and the confidence intervals spanning unity. Obese individuals, with an AOR of 0.41 ($p = 0.03$, CI = [0.18, 0.95]), had decreased odds of higher self-care compared to those with normal weight. Other variables such as marital status, gender, food insecurity, household monthly income, AUDIT score and distance travelled to access health care at a diabetes clinic were not statistically significant.

Table 4 Logistic regression results for self-care management ($n = 539$)

Independent variables	AOR	95% Confidence Interval
Age	1.02**	[0.99, 1.05]
Female	1.07	[0.52, 2.00]
Married	1.29	[0.73, 2.27]
Urban	0.54**	[0.30, 0.97]
Stable housing	2.2***	[0.78, 6.67]
Food insecurity	0.74	[0.36, 1.52]
Predicted monthly income	1.00	[0.99, 1.00]
Secondary education	1.13**	[1.02, 2.03]
AUDIT score	0.83	[0.42, 1.52]
BMI (overweight)	0.57*	[0.28, 1.16]
BMI (obese)	0.41**	[0.18, 0.95]
Travel time to clinic	1.00*	[0.99, 1.00]

The regression model was adjusted for Age, Female, Married, Urban, Stable Housing, Food Insecurity, Predicted Monthly Household Income, Secondary Education, AUDIT score, BMI Score, and Travel Time to Clinic as a proxy of distance travelled to access diabetes healthcare. Significance level Significance level 1%***, 5%**, 10% *

SDoH and self-care adherence

The multinomial logistic regressions in Table 5 demonstrate significant associations between key social determinants and self-care adherence practices, with partial adherence serving as the reference category.

Women demonstrated a decreased likelihood of non-adherence compared to men (AOR = 0.25; 95% CI = 0.06, 0.99; $p = 0.04$). Urban residents tended to be less fully compliant (AOR: 0.55; CI = 0.32, 0.97; $p = 0.03$), suggesting that urban living might pose challenges to consistent self-care. Stable housing emerged as a critical factor, significantly reducing the likelihood of no adherence (AOR: 0.18; CI = 0.04, 0.64; $p = 0.01$) and increasing the likelihood of full adherence (AOR: 2.24; CI = 0.77, 6.5; $p = 0.139$), highlighting its role in facilitating better self-care. Obesity was associated with lower odds of full adherence (AOR: 0.40; CI = 0.17, 0.94; $p = 0.03$). In addition, increased travel time to clinics, as a proxy to

Table 5 Multinomial logistic regression results for self-care guidelines adherence, $n = 539$

Independent variables	AOR(*NA)	95% CI(NA)	AOR(**FA)	95% CI (FA)
Age	0.96**	[0.90, 1.01]	1.01	[0.98, 1.04]
Female	0.25***	[0.06, 0.99]	1.03	[0.52, 2.03]
Urban	0.69	[0.19, 2.50]	0.55**	[0.32, 0.96]
Household income	1.00	[0.99, 1.00]	0.99	[0.99, 1.00]
High school completed	0.66	[0.13, 3.20]	0.13	[0.02, 1.03]
Stable House	0.18***	[0.05, 0.64]	2.24	[0.76, 6.54]
BMI (Overweight)	4.46	[0.43, 46.23]	0.57*	[0.28, 1.15]
BMI (Obese)	5.79	[0.47, 71.35]	0.40**	[0.17, 0.94]
Travel time to Clinic	0.94**	[0.88, 0.99]	0.99	[0.99, 1.00]

*NA no adherence, **FA full adherence

NB Partial adherence (PA) was the reference category Significance level 1%***, 5%**, 10% *

distance travelled to access diabetes care, was associated with small but significant reductions in the odds of non-adherence (AOR: 0.942; CI = 0.888, 0.999; $p = 0.04$). This suggests that accessibility may play a role in influencing engagement in self-care practices.

Discussion

This study examined the influence of various SDoH factors, including socioeconomic status, education, household stability, lifestyle, and health and healthcare domains, on adherence to diabetes self-care guidelines. Among the findings, 88% of participants reported lower self-care scores (≤5 days), while 86% of participants reported partial adherence to self-care. Significant predictors included age, urban residence, primary education, and BMI. Notably, lower rates of self-care are associated with more diabetes complications and clinic visits, with 73% of those who missed diabetes clinic appointments in the last three months did not reschedule or attend in the previous three months. Furthermore, 60% of participants visited the diabetes clinic 2 to 3 times in the last 3 months, exceeding the SEMDSA[2] recommendation of once every 3 or 6 months [37], while 86 of participants reported partial adherence with self-care. Several factors could contribute to this higher frequency of visits. Firstly, it may indicate a higher burden of diabetes complications or uncontrolled diabetes in this population, necessitating more frequent monitoring and adjustments in treatment [38]. Secondly, it could reflect a lack of access to or familiarity with self-management practices, leading to increased reliance on healthcare services [28]. Additionally, socio-economic factors, such as limited access to medication or healthcare advice outside of a clinical setting, might compel patients to seek more frequent in-person consultations [28, 38].

Analysis suggests slight improvements in self-care for older participants, possibly due to increased health awareness, access to care for other health conditions, and the longer duration of their diabetes. Longitudinal studies have also linked age to improved diabetes self-management and glycemic control [25, 32]. Conversely, overweight and obese individuals in urban areas were less likely to report adherence to self-care guidelines, potentially attributed to physical constraints, comorbid conditions related to BMI, as well as the availability of resources and opportunities in urban townships for healthy eating and exercise [34]. The finding that urban residency significantly reduces the likelihood of higher self-care aligns with existing evidence suggesting that, despite typically having better access to healthcare resources and diabetes education [29], urban residents may face unique challenges that impact their engagement in self-management. While awareness of diabetes management is high, self-care is often impeded by stress, lack of access to fruits and vegetables, and environmental factors [39]. Urban challenges, particularly safety concerns and inadequate outdoor exercise spaces, hinder physical activity and healthy diet, a vital element of diabetes self-care [40].

Individuals with secondary-level education showed higher odds of effectively managing their condition. Lower educational attainment, often linked to limited health literacy and fewer resources for self-care, can be exacerbated by lower socioeconomic status. Conversely, higher literacy levels promote judgment and decision-making, encouraging adherence to self-care [6, 41]. Considering these findings, policymakers should contemplate initiatives encompassing accessible health educational programs, informational materials, and community outreach efforts, specifically targeting individuals with lower educational attainment and socioeconomic status. These initiatives may enhance awareness and understanding of effective diabetes self-care management [6, 41].

This study found that food insecurity is associated with lower self-care management in diabetes, but its impact is less pronounced. This aligns with the existing literature, noting a similar link between food insecurity and reduced diabetes self-care management [42]. Notably, monthly predicted household income did not show association with higher self-care management. This may be due to the predominantly low-income sample, with a 70% unemployment rate and incomes below South Africa's minimum wage [20]. The study's unique characteristics, including high unemployment and pensioner rates, suggest that income may not be the primary determinant of higher adherence to diabetes self-care guidelines in this population.

Gender and marital status did not show an association with higher self-care management in this sample, contrary to some assumptions and existing literature [6] that emphasise their role in health outcomes. Additionally, despite the presence of hazardous drinkers and current smokers (25%), alcohol consumption and smoking did not significantly impact self-care behaviours in this demographic.

Regarding self-care adherence, women showed slightly higher adherence with self-care practices, which aligns with findings from a similar study in Egypt [40], suggesting a similar pattern across different cultural contexts. This gender-specific trend in self-care adherence may be influenced by the generally higher health awareness and engagement in preventive healthcare behaviours observed in females [30, 43]. The correlation between

[2] Society for Endocrinology, Metabolism and Diabetes of South Africa.

urban residence and reduced adherence in our study may be linked to the challenges posed by urban lifestyles, which often include sedentary behaviours and increased consumption of unhealthy foods due to economic development [43–45]. These findings emphasise the importance of considering gender and urbanisation when developing targeted interventions to promote self-care practices.

Other studies align with our findings, indicating a correlation between those who are able to access health care and those who are proactive in diabetes self-management [26, 46]. These individuals, familiar with healthcare settings, may be more inclined to inquire about their diabetes care, thus enhancing their self-management practices. This finding supports the idea that promoting self-care is a cost-effective and beneficial strategy, in contrast to frequent healthcare facility visits that can impose considerable provider costs [39]. It underscores the importance of further research to uncover predictors of healthcare system navigation and its connection with diabetes self-management in this population. In addition, the varying significance of income across different analytical groups emphasises the need for methodological rigour and a comprehensive, empirically grounded approach to explain the complex interplay among socioeconomic factors, healthcare services access, and self-care management.

Frequent healthcare visits were associated with participants reporting suboptimal self-care, deviating from daily diabetes management practices. This pattern, imposing both direct and indirect costs on healthcare systems and patients [39, 47], highlights the need for interventions aligned with the American Diabetes Association (ADA) and SEMDSA standards to mitigate complications. It also suggests the importance of healthcare providers tailoring their advice to patients' perceptions and circumstances for effective self-care [35, 39].

This study identifies several key areas for further investigation to enhance understanding of diabetes self-care management. These include exploring the underlying factors such as healthcare access, cultural attitudes, and environmental influences, examining the impact of income and economic diversity on self-care practices, investigating the role of lifestyle factors in self-management, and understanding the reasons behind high clinic visit frequency. Consolidating these research directions will provide a comprehensive roadmap for future studies to deepen our understanding and improve diabetes care strategies.

This study has limitations, including not accounting for confounding variables like media exposure to diabetes information, family history, comorbidities, or traditional medicines. The assessment of self-care practices was confined to a 7-day period, not capturing long-term adherence impacts on glycemic control. Its cross-sectional nature restricts causal conclusions, and reliance on subjective self-care assessments may introduce recall and social desirability biases. Additionally, it is important to note that the analytical sample was part of a cluster randomised controlled trial (cRCT), where two arms received interventions for depression or alcohol use. Although these interventions were not administered at baseline, this sample may represent a lower mental health status compared to the average diabetic dependent on government health services, potentially influencing the study outcomes.

This study also acknowledges BMI's potential endogeneity but does not correct it due to the complexity of applying methods like instrumental variables within the constraints of cross-sectional data. This limitation necessitates a cautious interpretation of BMI's influence on diabetes self-care as associative, not causal, and underscores the need for further causally oriented research using more robust statistical techniques to clarify these effects.

The decision to recode the continuous TTO utility score into ordinal categories while enhancing interpretability and model suitability potentially limits the analysis by reducing the granularity of data. This transformation may obscure subtle but clinically important variations within the utility scores, which could be crucial for detailed econometric modelling and precise health outcome assessments. Future studies should consider incorporating methods that maintain the continuous nature of TTO scores to capture a more nuanced understanding of health utilities. Although initial explorations indicated a low risk of multicollinearity due to distinct categorical variables and a moderate number of predictors, the lack of formal multicollinearity testing in the reporting could impact the transparency and reliability of the findings. Formal testing in future studies will enhance the statistical robustness and credibility of the results. Reclassifying continuous self-care scores into 'Low' and 'High' categories simplifies analysis but may lead to a loss of detailed information, potentially obscuring nuanced differences in self-care practices. Future research should consider models that retain the continuous nature of the data to capture more comprehensive insights. Nevertheless, this analysis carries substantial implications for future intervention strategies and policy frameworks, providing a foundation for understanding the multifaceted determinants of diabetes self-care management in South Africa as diabetes prevalence continues to rise.

Conclusion

The investigation sheds light on the multifaceted nature of social determinants impacting diabetes self-care management, with varied adherence levels to diabetes self-care practices among participants. The findings highlight the importance of socio-demographic factors in diabetes self-care and suggest that interventions should consider these variables to improve self-care practices among individuals with diabetes. Future studies should delve deeper into these associations and broaden the investigative scope to encompass other socioeconomic and environmental determinants. Such a comprehensive approach may set the foundation for more robust, tailored interventions aiming to ameliorate a higher activity scale of self-care management and overall health outcomes for individuals with diabetes within the South African setting.

Authors' contributions
AH conducted data analysis and wrote the main manuscript. APK, SC AO, and OA provided technical advice. Professor Naomi Levitt and Professor Bronwyn Myers reviewed the final version of the manuscript.

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Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate
Ethical clearance was obtained from the Human Research Ethics Committee (HREC) of the University of Cape Town before data analysis (646/2022). This study utilized data from Project MIND participants, who had given consent for their data to be used in subsequent research.

Consent for publication
All authors agree for the last version to be published.

Competing interests
The authors declare no competing interests.

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